ementing Design Principles to Enhance Energy Efficiency

Printer Friendly Version Send to a Friend

ıplementing Design Principles to Enhance Energy Efficiency ırt II

lished February 07 2007

ding research facilities to operate at the highest possible level of energy efficiency requires the lementation of specific design strategies aimed at maximizing resources and increasing savings. In , including certain design principles in the planning stages of new science buildings can result in a ıction of between 30 and 50 percent in energy costs, creating billions of dollars in annual savings.

Complete Story

I of this series discussed the first five of 10 design strategies geared toward ancing operating efficiency and lowering energy costs. The strategies ıde focusing on programming, planning a rational layout, zoning ropriately, capitalizing on climatic forces, and creating the best structure for num daylighting. Part II examines the remaining design strategies and how can be used to further enhance energy efficiency. The strategies were ıted by Paul Mathew, a staff scientist at Lawrence Berkeley National oratory (LBNL) in Berkeley, Calif., and Joe Collins, a partner at Zimmer sul Frasca Architects in Portland, Ore.

rutinizing Air Changes

important to analyze the air changes and question the requirements and vation behind these changes. Ventilation has a huge impact on overall ating costs not due just to the energy required to move the air, but also due ıe energy required to heat and cool the air, particularly in extreme climates. ventilation rates are often overestimated, so do not assume the air change is always driven by thermal loads. Additional changes do not necessarily ate to increased safety.

se optimum minimum ventilation requirements on user needs, health and ty protection, and energy consumption," says Mathew. "The environmental th and safety officers usually set the rates, so designers need to work with n to optimize the rates. Consider design options, including exhaust natives, computational fluid dynamics (CFD) modeling, a panic switch for rgency airflow in case a spill occurs, cascading air use from clean areas to areas, and occupancy sensors or a schedule-driven approach to change the when the space is not occupied."

performing CFD modeling of indoor airflows, designers can study airflow erns and optimize the position of supply diffusers, return grilles, and fume d locations relative to work surfaces and, thereby, improve the effectiveness ıe airflow.

ventilation rate seems to differ among research facilities and correlates with rresponding difference in energy usage. Owners, architects, and engineers ıld inquire about what the proper rate should be in order to achieve maximum ty and savings.

chinson Hall at the University of Rochester is an example of a building that 10 air changes per hour, which represents an original standard set at least decades ago. The environmental safety and health officer was asked why rate was set at 10 and whether the potential hazards were reviewed. After ewing the rate and its subsequent ramifications, the officer defined various ard levels for different types of laboratories. This approach is called control ding. In each one, there was an occupied setting, as well as an unoccupied ng for the air change rate.

issue of fume hoods being massive beasts of energy consumption must be sidered, as well. A single fume hood consumes as much energy as three age homes, while a lab with 100 hoods utilizes as much energy as a small hborhood. The LBNL provides an online tool at ://fumehoodcalculator.lbl.gov that enables users to compare fume hoods. mation about the type of hood, the price of electricity and gas, as well as the ate zone, can be entered into the system and the calculator will make parisons between fume hoods. The calculator can be used to test the energy cost impacts of improving component efficiencies and comparing options.

rything owners and programmers can do to reduce the number and the size ıme hoods is the best way to improve energy efficiency," says Mathew. ke sure you allow for easy additions and removals to alleviate concerns from lty who think if it is not done now, it will never be installed. Consider variable olume (VAV), two-speed fume hoods, the new generation of -performance hoods that use a different airflow pattern and provide excellent ainment with much lower volumes."

duce the Pressure Drop

roximately 50 percent of the total heating, ventilation, and air conditioning

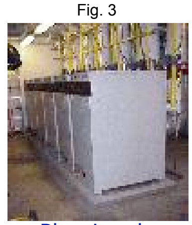
Biographies

Paul Mathew is a staff scientist at Lawrence Berkeley National Laboratory where he works on applied research in energy efficiency and environmental sustainability.

For more information

Click here to contact Paul Mathew and Joe Collins.

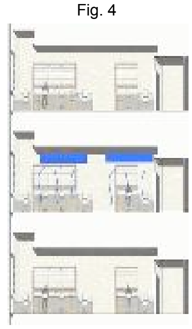
Fig. 3



Plug Loads

Mechanical equipment should be right-sized to save capital and operating costs. The Lawrence Berkeley National Laboratory in Berkeley, Calif., replaced two large boilers with 11 smaller, modular boilers similar to the ones shown here. (Photo courtesy of Zimmer Gunsul Frasca Architects.)

Fig. 4



ıe University of California, Davis Tahoe Center for Environmental Sciences, neers looked at the base case of the air handler, which was 2.2 inches of ɜr gauge (w.g.) and dropped it to 0.68 w.g. The duct work was kept as straight short as possible with large ducts. As a result of including these strategies, engineers achieved a pressure drop that resulted in decreased energy usage.

t Real with Plug Loads

ı loads are basically the heat loads that result from any lab equipment that iires electricity and generates heat. HVAC systems are often oversized out of that a facility might not be able to meet over-estimated plug loads in the ·e. As a result, chillers and air handlers are often oversized and this leads to ɛcessary expense and wasted operating cost in the long term.

:hanical equipment should be right sized to save capital and operating costs. ɗy actual loads at comparable facilities to fully understand the real load, g improved estimates of heat gain from plug loads.

d out what the plug loads are at a comparable lab and then start your sizing ɜd on that rather than an arbitrarily high number," suggests Mathew. "You d to design for high part-load efficiency because labs aren't always going to ·ate at peak loads. One of the ways you can do this is by using a modular ·oach."

example, two large boilers at the LBNL were replaced with 11 smaller, lular boilers. Each boiler kicks on as needed as the load ramps up. No more ı seven of the boilers have operated simultaneously, leaving four completely ındant and demonstrating how oversizing occurs.

Davis is concerned about plug loads and is using right-sizing, in part, ause of tight construction budgets and the need to minimize the impact of ɜ mechanical equipment. In order to accomplish these objectives, the ɾersity began sizing to a 15-minute average peak rather than an antaneous peak. Electrical systems must be sized accordingly, but :hanical systems should be sized for a lower quantity.

ıt sizing is also being used at the Molecular Foundry Laboratory at the keley Lab. The air handlers and electrical generators were downsized, ılting in a multi-million dollar initial cost savings. Some of the money saved applied toward additional green features that qualify the facility for a ɜr-level LEED certification.

st Say No to Reheat

id systems that require simultaneous heating and cooling. High-load areas iire lower supply air temperature, so reheat occurs in other spaces. ultaneous heating and cooling is problematic in labs where variations of ·nal loads can be enormous. A single zone requiring cooling can create icial heating and cooling loads throughout a building.

ɜre are systems that can be designed to avoid reheat and simultaneous :ing and cooling. They involve decoupling of thermal conditioning from the ɔly of ventilation air," says Mathew. "For example, tempered air could be ɔlied to each lab space and then within each lab space fan coils can be d to take care of the heating and cooling loads in that lab space, so it is lized thermal conditioning with central ventilation supply."

erford College in Philadelphia uses two heat wheels to provide ɔerature-neutral air to the lab spaces. The heat wheel system requires the ɔly and exhaust points to be located in close proximity to each other, ılting in larger shafts. Within each space, fan coils were used to provide the l heating and cooling. The setup completely eliminates reheat in the ding.

ther scheme for decoupling and ventilation using passive chilled beams in spaces is being considered in the design of the Li Ka-Shing Center,)-million health science building that will be constructed at the University of fornia, Berkeley beginning in 2008.

ɜ cold beam has chilled water running through it and with a process of natural ɾection, the warm air rises, comes into contact with the cold beam, cools, then drops," explains Mathew. "It is a passive approach to effectively ing the space. Like any good system, it has to be properly engineered and ·rolled. It is important to remember that 55 degree air that you supply in a duct condensation risk and these passive beams are at a much higher ɔerature of about 62 degrees."

ll the Commissioner

e sure all systems are operating the way they are designed to work and that ɜquipment is installed in accordance with planning. There is less expense decreased risk when the commissioning is done prior to occupancy. If it is ɜ during the design, commissioning can avoid potential problems and ɔver possible opportunities to improve performance.

ımissioning ensures that systems operate as they are intended," says ɪew. "In labs, commissioning can be used to identify excessive reheat ·gy use and control sequences that are not properly implemented, such as air ıge setbacks during unoccupied periods."

Reheat

New chilled-beam technology can be used in labs to avoid systems that require simultaneous heating and cooling. A single-zone requiring cooling can create artificial heating and cooling loads throughout the building. (Photo courtesy of Zimmer Gunsul Frasca Architects.)

Fig. 5

Commissioning

All systems should operate the way they were designed to work. Commissioning the building by inspecting all systems prior to occupancy can avoid potential problems in the future. (Photo courtesy of Zimmer Gunsul Frasca Architects.)

, utility companies offer a "Savings by Design" program that reimburses for the initial capital cost of an energy saving measure, up to $150,000 of the incentive. In this case, the local utility company is so enthused about the ersity of California, Berkeley being a model project for other energy use ities, such as labs, that it has raised the standard contribution to the imum total incentive of $500,000, if certain performance levels are met.

those of you looking for sources of capital for your projects, don't forget ut energy efficiency because there is big incentive money available," says ins of Zimmer Gunsul Frasca Architects.

Tracy Carbasho

elcome your Questions and Comments

: 1096-4894

ilar Content

- Design Strategies Maximize Energy Efficiency in Science Buildings
  Proper Planning Results in Significant Cost Savings - 01-31-2007
- Yale University's Chemistry Research Building Employs Innovative Energy-Saving Measures
  LEED-certified Fume-Hood-Intensive Facility is Safe, Sun-filled, and Sustainable - 02-07-2007
- Canadian Buildings Utilize Sustainable Design Principles
  Research Facilities Plan for Existing and Future Needs Part II - 11-01-2006
- Total Cost of Ownership Steers Capital Projects and Operations at Intel
  Leading-Edge Management Model Provides Analysis for Facilities Management - 07-19-2006
- Sustainable Design Strategies Utilized in Canadian Science Buildings
  Cost-Effective Solutions for Achieving Environmentally Friendly Labs - 10-11-2006
- World BioHazTec Reviews Safety of Biocontainment Facilities
  Avoiding Common Deficiencies in Biocontainment Containment Labs - 07-05-2006
- Kelley Engineering Center Designed for Collaboration, Sustainability
  Center is on Track to be the Greenest Academic Engineering Building in the Nation - 01-31-2007
- Research Facility Designs for Long-Term, Economical Flexibility
  Strategies Outline How to Accommodate Future Adaptations - 11-22-2006
- Maximizing Lab Flexibility with Strategic Planning of Interstitial Space
  Evolving Infrastructure for Rapidly Changing Research - 11-22-2006
- Building Better Biosafety Containment Labs for the Future
  Planning High Efficiency, High Capacity BSL-Rated Integrated Animal Research Labs - 02-15-2006
- Uncovering Weaknesses of Biocontainment Facilities
  Addressing Features, Operating Protocols and Global Strategies - 06-28-2006
- ORNL's Advanced Microscopy Laboratory Houses Next-Generation Electron Microscopes
  Building Designed to Share Chilled Water, Compressed Air, and Power with HTML - 08-16-2006
- Cost-saving Strategies for Highly-functional Buildings
  Good Spending Decisions Yield More Building for Less Money - 12-06-2006
- Energy Recovery Using Refrigerant Run-Around Loops

Saving Operating Costs and the Environment As Well - 05-07-2003

- University of California Adopts System-Wide Green Building and Clean Energy Policy
  Diverse Stakeholders Come Together to Address Energy Consumption, Sustainability - 03-02-2005